# Section 2
# Data Generation and Acquisition

This section of the QAPP addresses all aspects of data generation and acquisition that will be performed during the Brockton Receiving Water Assessment SEP field sampling program. Adherence to the guidelines outlined in this section will ensure that the appropriate methods for sampling, measurement and analysis, data collection and generation, data handling, and quality control activities are employed and documented throughout the completion of the task.

## 2.1 Sampling Process Design (Experimental Design)

The following section provides a general overview of sampling network design and rationale for the design developed for the Brockton Receiving Water Assessment SEP. Specifics as to the types and numbers of samples required, exact sampling locations and frequencies, and sample matrices are addressed more fully in the Sampling and Analysis Plan developed for the Brockton Receiving Water Assessment SEP, submitted under a separate cover.

### 2.1.1 Sampling Network Design and Rationale

The field sampling program developed for the Brockton Receiving Water Assessment SEP has been designed to meet the DQOs discussed in Section 1.4 - Quality Objectives and Criteria.

#### Study Area Definition

For the purposes of the field sampling program, the Study Area has been defined as the tributaries and mainstem river of the Salisbury Plain and Matfield River subwatersheds of the Taunton River Watershed from upgradient of the Brockton AWRF to the confluence of the Matfield and Town Rivers as described in Section 1.3.1.

The Study Area delineation was defined in the Consent Decree, Civil Action Case No. 1:06-cv-11334-NMG (September 28, 2006), Appendix A.

#### Low Flow Sampling Activities

This section describes the overall sampling schedule, general sampling locations, water quality parameters, and biological sampling and habitat assessment activities to be performed as part of this field sampling program. Specific requirements will be detailed further in the Sampling and Analysis Plan, submitted under separate cover.

*Sampling Schedule.* Sampling will be targeted for dry weather, low-flow conditions typically occurring in August. Actual sampling may occur any time in the months of July, August, or September as judged by the flow criteria.

Two low flow sampling events are scheduled to be performed during the sampling program, in August 2010 and August 2011, as conditions permit. Timing of these events is dependent upon prevailing precipitation conditions during the summer months (July - September).

***Event Definition*** Low-flow water quality sampling will be conducted when streamflow conditions are at August median flows or lower at USGS streamflow monitoring gage 01108000 on the Taunton River. In addition, antecedent precipitation reported at the Taunton, Massachusetts NOAA weather station (http://www.erh.noaa.gov/box/dailystns.shtml) will total less than 0.1 inch for the 48 hours preceding the low-flow survey. Table 2-1 shows flow values for the USGS gage as well as the flow criteria for low-flow sampling.

***Table 2-1:*** *Target Streamflow for Low Flow Sampling Surveys*

| Gage Name | Gage Number | August Median Flow[2] | Target Streamflow (flow should be ≤ value) |
|---|---|---|---|
| Taunton River Near Bridgewater[1] | 01108000 | 92 cfs | 92 cfs |

1. USGS gage #01108000, historical data from 10/1/1929 – 9/30/2009
2. Calculated as the average of the daily median flows for August 1 – 31.

Diurnal dissolved oxygen measurements (i.e., "diurnal sweeps") will be conducted during the two summer low-flow sampling events at the main stem sampling locations. The sampling stations identified as diurnal sweep locations are listed in the SAP along with the low-flow survey sampling location information. One round of measurements will be taken at dawn when DO concentrations are typically at their lowest, while a second round of measurements will be performed in the mid to late afternoon when DO concentrations tend to be highest.

It should be noted that the low flow sampling event can occur at any time during the summer months July - September, whenever the target streamflow listed in Table 2-1 is met.

***General Sampling Locations***. The sampling locations are specifically defined in the Sampling and Analysis Plan for summer low flow surveys, and have been selected in accordance with the following three categories to meet the DQOs stated in Section 1.4:

- Background Sampling: Measure instream pollutant concentrations in the Salisbury Plain River upstream of the Brockton AWRF.
- Source Sampling: Calculate the pollutant loads entering the Salisbury Plain River and Matfield River from major tributaries and measure pollutant concentration discharges to the Salisbury Plain River and Matfield River.
- Instream Response: Measure the instream pollutant concentrations in the mainstem of the Salisbury Plain and Matfield Rivers downstream of major tributaries.

Table 2-2 presents a summary of the general sampling locations that will be surveyed during low flow events. Additional details are provided in the Sampling and Analysis Plan. The number and type of sampling may be modified in the Sampling and Analysis Plan to remain within the budget upper limit.

*Table 2-2: Summary of General Sampling Locations*

| Sampling Category | Station | Chemical | Biological / Habitat |
|---|---|---|---|
| Background Sampling | 1 – Upstream of the Brockton AWRF | X | X |
| Source Sampling | 2 – Downstream of the Brockton AWRF | X | X |
| | 4 – Beaver Brook at Belmont St. | X | |
| | 6 – Meadow Brook at W. Union St. | X | |
| | 7 – Satucket R. at Plymouth St. | X | |
| In-stream Response | 3 – Salisbury Plain R. at Matfield St. | X | X |
| | 5 – Matfield R. at W. Union St. | X | X |
| | 8 – Matfield R. at state hwy. 18 | X | X |
| | 9 – Matfield R. at High St. | X | X |
| | 10 – Town R. at Hayward St. | X | |

***Water Quality Parameters***. In general, the water quality parameters selected for analysis in this study have been shown to affect the designated uses in the Study Area, including nutrients, which in turn affect DO levels. A summary of the field and laboratory measurements to be performed under this field program is provided in Table 2-3. The specific sampling matrices for this program are outlined in the Sampling and Analysis Plan.

*Table 2-3: Field and Analytical Analyses*

| Analytical Measurements | Field Measurements |
|---|---|
| Nutrients and Impacts<br>• Total Phosphorus<br>• Dissolved Orthophosphorus<br>• Nitrate/Nitrite<br>• Total Kjeldahl Nitrogen (TKN)<br>• Ammonia-N<br>• Periphyton Chl-a<br>• Phytoplankton Chl-a<br>Oxygen and Oxygen Demand<br>• Dissolved Oxygen (Winkler Titration) | • *In situ* measurements<br>o Temperature<br>o Dissolved Oxygen (DO)<br>o pH<br>o Conductivity<br>• Turbidity |

In freshwater, phosphorus in particular plays a major role in controlling the growth of algae and aquatic plants, and most fresh waters are phosphorus-limited. As a result, a laboratory analysis method was chosen that would detect low levels of phosphorus compounds meaningful for assessing nutrients in the water body. Additionally, low DO concentrations may adversely affect fish populations. Dissolved oxygen will be measured both as a field parameter at all stations and as a laboratory measurement (Winkler Titration) at select stations to provide a check on the field probes.

*In situ* measurements of temperature, DO, pH, conductivity and turbidity will be performed at all instream sampling locations.

***Instream Flow Monitoring***. The USGS operates a streamflow gaging station (01108000) along the mainstem of the Taunton River within the Study Area (see Figure 1-1). The location of this gage is at latitude 41o56'02", longitude 70o57'25", Plymouth County, Hydrologic Unit 01090004, on right bank at bridge on Titicut Road, 1 mi upstream from Sawmill Brook, 3.5 mi northwest of Middleboro, and 4.0 mi southeast of Bridgewater. Real-time gage data can be downloaded from:
http://waterdata.usgs.gov/ma/nwis/uv?cb_00060=on&cb_00065=on&format=gif_default&period=7&site_no=01108000.

## 2.2 Sampling Methods

This section describes the procedures for collecting samples and identifies the specific sampling equipment and performance requirements, sample preservation requirements, and decontamination procedures. Also addressed are the procedures for identifying sampling or measurement system failures and for implementing corrective actions.

Chemical monitoring performed during this sampling program will include the collection of grab samples, *in situ* field measurements, and quality control (QC) samples. Specific SOPs are listed in Table 2-4 and compiled in the "SOP Compendium," submitted under separate cover. The use of SOPs will ensure the collection of accurate, precise, and representative samples, as well as helping to ensure data comparability and usability. All sampling procedures will be discussed in-depth at a preliminary field training meeting to be held prior to initiation of the sampling program. The field program will not require the use of any new or innovative procedures or sampling techniques.

*Table 2-4: Summary of SOPs for Sampling Surveys*

| SOP | Title |
|---|---|
| SOP-DOC-001 | Field Logbook Content and Control |
| SOP-FLD-001 | Collection and Handling of Water Samples for Water Quality Analyses |
| SOP-FLD-002 | Determination of Dissolved Oxygen (Modified Winkler, Full Bottle Technique) |
| SOP-FLD-003 | *In-Situ* Water Quality Measurements |
| SOP-FLD-004 | MADEP SOP CN 39.2, "Water Quality Monitoring In Streams Using Aquatic Macroinvertebrates" |
| SOP-FLD-005 | MADEP SOP CN 060.0, "Benthic Algae: Micro and Macro Identifications and Biomass Determinations" |
| SOP-FLD-006 | MADEP SOP CN 075.1, "Fish Collection Procedures for Evaluation of Resident Fish Populations" |
| SOP-FLD-007 | MADEP SOP CN 67.2, "Aquatic Plant Mapping" |
| SOP-FLD-008 | Operation of Global Positioning Systems (GPS) |
| SOP-FLD-009 | Determination of Turbidity in Water |
| SOP-FLD-010 | Bucket Cleaning Procedures |
| SOP-FLD-011 | Determination of Light Transparency (Secchi Disk) |

Sampling methods for biological monitoring will follow procedures outlined in CN 226.0, QAPP Benthic Macroinvertebrate Program, which is included in the SOP compendium (Appendix C).

## 2.2.1 Preparation Procedures

**Weather Tracking and Field Mobilization**

Preparation for sampling activities includes weather tracking, review of SOPs, procurement of field equipment, laboratory coordination, confirmation of site access (if necessary), and coordination. Weather tracking will be performed by the Technical Project Manager and CDM's Field Program Coordinator. Precipitation forecasts will be based on meteorological forecast models provided by the National Weather Service. Although it is difficult to specify the accuracy of the precipitation forecasts for a particular area, according to the Boston National

Weather Service's recent records, their precipitation probability forecasts range from 69-percent accurate (0 to 12-hour forecasts) to 56-percent accurate (24 to 36-hour forecasts) based on the 1999 data (Marc Wallace, CDM, personal communication, February 20, 2003).

Once in the field, initial set-up will include establishment of sample staging areas, distribution of required equipment, and distribution of bottles and coolers provided by the subcontracted laboratories.

**Decontamination Procedures**

All materials used during sample collection, such as collection buckets, funnels, and stirring rods, will be decontaminated between samples and after use in accordance with SOP-FLD-010: "Bucket Cleaning Procedures." Investigation-derived waste (IDW) will not be generated during any part of this investigation.

## 2.2.2 Water Quality Sample Collection

This section describes the procedures that will be used to manually collect grab samples and *in-situ* measurements for chemical sampling events.

Samples will be collected using a peristaltic pump, Van Dorn-style sampler, or pole sampler at stations with water depths are greater than three-feet, or approximately one-meter. Samples will be collected from the approximate midpoint of the water depth at all stations less than three feet deep.

Pre-labeled bottles will be provided to each sampling team for each station and sampling run. Samples will be collected in accordance with SOP-FLD-001: "Collection and Handling of Water Samples for Water Quality Analysis," and the following procedures.

If a boat is required,

- All samples should be collected from the upstream side of the boat to prevent contamination from the boat or disturbed sediments.
- Rinse any sampling equipment three times with river water from the location to be sampled.
- Where a peristaltic pump is used, purge the pump and hose with at least three volumes of water at each station prior to collecting samples.
- Collect a sample from the middle of the depth using the pump.
- Where water depth is greater than three-feet (approximately one-meter), collect one 1.5-gallon sample (at each quarter point station) as the pump is raised through the water column at a steady rate; pump into carboy. For stations with shallower depths, pump one 1.5-gallon sample from the midpoint of the water depth.

- Mix the carboy thoroughly by gently swirling the collection container.
- Record the date, time, location, volume and other pertinent information about each sub-sample in the field logbook.
- Fill laboratory bottles with spatially composited sample in accordance with the following procedures:

  o For pre-preserved bottles (*i.e.* nutrients):

  - Pour the sample in the laboratory bottle taking care not to overflow the container.
  - Be sure not to touch the inside of the bottle or the cap. Caps may be placed in a clean, dry plastic bag while samples are collected, if needed.

- Label bottle with appropriate information.
- Place sample in cooler with ice.
- Fill out field data collection worksheet.

It is critically important not to disturb the bottom sediments when collecting the samples at each site. If this occurs, the sample should be collected at the other end of the boat to avoid entraining sediment in the water sample. A note should be made in the field logbook describing the problem and corrective action taken; the sampling team should notify their respective Field Program Coordinator following the sampling event.

During each sampling event, equipment blanks will be collected at one station to assess cross-contamination between sampling stations. The frequency of equipment blank collection will be at least 10 percent, or one equipment blank for each round of 10 samples.

Specific collection procedures are provided in SOP-FLD-001: "Collection and Handling of Water Samples for Water Quality Analysis."

### 2.2.3 *In Situ* Measurements

The following section describes the procedures that will be used to perform the various *in situ* measurements that will be required during the field sampling program; these include:

- *In situ* temperature, pH, dissolved oxygen, and conductivity measurements
- Diurnal dissolved oxygen measurements
- Turbidity measurements

For all *in situ* measurements:

- Sufficient time will be allowed in order for each parameter value to stabilize, as applicable
- The probe(s) will not be allowed to touch the bottom sediments

All data will be recorded on the appropriate field data collection sheet.

**Temperature, pH, dissolved oxygen, and conductivity**

During low-flow surveys, *in situ* dissolved oxygen, specific conductance, pH, turbidity and temperature measurements will be made instream at the center point of the sampling stations. Readings will be taken approximately at the midpoint of the river depth (*i.e.* 50-percent of the water depth).

**Diurnal dissolved oxygen measurements**

Diurnal dissolved oxygen measurements will be collected during two low-flow sampling events at select stations. The first round of measurements will be made at approximately dawn (i.e., between 5 a.m. and 8 a.m.) when it is anticipated that dissolved oxygen concentrations will be at their lowest; the second round of sampling will be performed in the mid- to late-afternoon (*i.e.* between 1 p.m. and 5 p.m.) when dissolved oxygen concentrations will be at a maximum.

Measurements will be made instream using a portable water quality unit at the quarter points of the river cross-section for each sampling station. The procedures discussed in SOP-FLD-003: "*In-Situ* Water Quality Measurements" will be used. Measurements will be made at approximately the midpoint of the river depth (*i.e.* 50 percent of the water depth), since it is assumed that all instream stations will be sufficiently mixed vertically to prevent stratification (except immediately upstream of the dams).

The three dissolved oxygen measurements for each station will be recorded on the appropriate field data collection sheet; the averaged value will be considered representative of the dissolved oxygen concentrations at each water quality monitoring station.

**Turbidity measurements**

Turbidity measurements will be made in the field from a sample collected at the time that sample bottles are filled for laboratory analysis. SOP-FLD-009, "Determination of Turbidity in Water," will be followed.

## 2.2.4 Biological Monitoring

Biological monitoring will include benthic macroinvertebrates and habitat assessment, periphyton assessment, and macrophyte assessment. The biological monitoring will follow DWM Standard Operating Procedures (SOP) for macroinvertebrates, macrophytes, and benthic algae.

All sites will be selected in advance. All sites will be comprised of a single 100-meter reach that contains representative habitats such as pools, riffles, and runs (when present). Natural physical barriers or block nets will mark the upstream and downstream ends of each site.

Biological monitoring will follow procedures outlined in CN 226.0, QAPP Benthic Macroinvertebrate Program, which is included in the SOP compendium (Appendix C).

**Benthic macroinvertebrates**

Personnel will perform biomonitoring of benthic macroinvertebrates using the protocols in DWM's SOP CN 39.2, "Water Quality Monitoring In Streams Using Aquatic Macroinvertebrates" The MADEP SOP 39.2 includes considerations for deciding which sampling method to use: kick sampling, rock baskets, or multiplate samplers. Kick samples are preferred in wadeable streams with coarse substrates. Rock baskets are recommended in deeper, non-wadeable streams and where substrates may be too fine for kick sampling. Multiplate samples (such as modified Hester-Dendy samplers) are often used in deep rivers where kick sampling is inappropriate and where deployment and retrieval of rock baskets is impractical. Rock baskets and multiplate samplers must be deployed 6-8 weeks prior to collection to allow macroinvertebrates enough time to colonize the substrates, adding complexity to the fieldwork. It is possible or likely that multiplate samplers will need to be used for the biological monitoring.

All sites will be evaluated in June 2010 to determine which sampling method is suitable for the conditions.

Where kick sampling is appropriate (preferred), the following protocol will be followed:

- Ten kick samples will be collected by kicking/rubbing/dislodging invertebrates from a 0.5x0.5m area and having dislodged materials flow into a kicknet (500 um mesh) firmly positioned immediately downstream.
- If shallow riffle habitats are limited, productive habitats may be sampled by taking kick samples or jab samples.
- All ten samples will be combined into a single composite sample and personnel will record the locations, sampling method, and habitat conditions for each sample that contributes to the composite sample.
- Large materials in the composite sample, such as rocks and sticks, will be cleaned and rinsed in the net to remove any clinging invertebrates and then returned to the stream. Residue—which will include finer sediments, particulate organic matter, and macroinvertebrates—will be emptied into a 2 L leak-proof Nalgene bottle. One or more bottles will be used to hold the entire composite sample for each site.

- Samples will be preserved in the field using 100% reagant alcohol (5% methanol, 5% isopropanol, 90% ethanol) added to cover the residue in a volume roughly equal to the sample materials in the bottle.

- A label indicating the sample identification code, date, water body name, sampling location, and collector will be placed in each bottle. These will be printed on waterproof paper using a Laser printer. The date, sample identification code, and preservative type will be marked on the outside of each bottle.

- A duplicate kick sample will be collected at one of the sample sites (to be determined) to assess the consistency of the sampling effort. Ten duplicate subsamples will be collected alongside the primary samples and composited and preserved in a similar manner. The label(s) and bottle(s) will be clearly be marked as "duplicate".

- After sampling is completed at a given site, all collecting equipment will be rinsed thoroughly, examined for residue, and picked free of organisms to ensure against cross-contamination between sites.

For sites where multiplate samplers are required, the deployment and collection method will be as follows:

- Samplers will have round plates and spacers that meet EPA specifications. Samplers deployed in deep water will be tethered to an anchored float to keep the sampler suspended one meter below the water surface. Samples deployed in shallow water will be mounted to a patio block. All samplers will be placed in a similar range of flow conditions (0.15-0.75 m/s).

- Precise locations and habitat conditions for each multiplate sampler will be recorded when they are deployed and collected to determine if there was significant movement or habitat changes during the colonization period.

- Samplers will need to be deployed in June 2010 to allow adequate colonization by the August collection period. Ten multiplate samplers will be deployed at each site.

- During the collection period, the presence and condition of each sampler will be noted. Suspended samplers that had fallen, bottom samplers that had become buried, or samplers dewatered at the time of collection will be eliminated from the analysis.

- The multiplate samplers will be collected by enveloping them in a 500 um net without disturbing colonized invertebrates, then placed directly into a 2 L bottle (one for each sampler). Any invertebrates dislodged within the collecting net will be added to the bottle.

- Samples will be preserved in the field using 100% reagant alcohol (5% methanol, 5% isopropanol, 90% ethanol).

- A label indicating the sample identification code, date, water body name, sampling location, and collector will be placed in each bottle. These will be printed on waterproof paper using a Laser printer. The date, sample identification code, and preservative type will be marked on the outside of each bottle.

- Samplers will be cleaned (disassembled and brushed/scrubbed to remove invertebrates) in the lab and all ten samples will be combined into a single composite sample.

**Habitat assessment**

Personnel will perform a visual habitat assessment at the time of the sample collection using the "Biomonitoring Field Data Sheet" and "Habitat Assessment Scoring Sheet" provided in the DWM's SOP CN 39.2, "Water Quality Monitoring In Streams Using Aquatic Macroinvertebrates." Two to three people will work together to complete the habitat assessment for each site, attempting to reach consensus for each habitat parameter before completing each form.

**Periphyton**

Benthic algae/periphyton can be used to assess above and below a point source or nonpoint source to look for nutrient impacts or toxicity issues. Changes in the community assemblage of the algae are examined as well as differences in algal biomass which is evaluated through determination of percent cover, chlorophyll a and/or ashfree dry mass from artificial substrates and natural substrates.

Based on communication with MADEP (5/12/2010) the CDM Team will only assess percent coverage without identification or biomass determination for the purposes of this assessment. Percent coverage is used as an adjunct to other chemical and biological indicators as an indication of nutrient enrichment. MADEP SOP CN 060.0, "Benthic Algae: Micro and Macro Identifications and Biomass Determinations," will be used to perform the percent coverage determination. Additional details will be provided in the Sampling and Analysis Plan.

**Macrophytes**

Procedures from MADEP SOP CN 067.2, "Aquatic Plant Mapping," will be adapted to the river setting. Mapping percent cover gives a semi-quantitative assessment of the general density of plants and can be used in assessment for support of aquatic life, boating and swimming. The density of plants is related to the sediment type and nutrient conditions (generally greater densities are found in nutrient rich organic sediments, particularly terrestrial soils that have been flooded). Biovolume mapping will not be performed, since assessment of boating and swimming uses are not a goal of this project. (Biovolume mapping is essentially similar to density mapping, but the addition of depth of the plant beds is used to help in assessment of boating and swimming uses.) Species distribution maps will be generated for use in determining the type of plant community and for tracking changes in species dominance or expansion of beds across the river over time. If time permits, a Secchi disk reading will be taken

at the deepest point, and the reading recorded (see SOP-FLD-011, "Determination of Light Transparency [Secchi Disk]," for further details).

**Fish population survey**

If performed for this study, the CDM Team will perform fish population surveys at selected sampling stations following the Fish Collection Procedures for Evaluation of Resident Fish Populations SOP (CN 075.1). MADEP developed the SOP based on U.S. EPA Rapid Bioassessment Protocol V (Barbour, Michael; Gerritsen, Jeroen; Snyder, Blaine; and Stribling, James. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: Periphyton, benthic macroinvertebrates and fish. U.S. Environmental Protection Agency, Washington, D.C. EPA 841-B-99-002), to improve data comparability among wadeable sampling sites throughout the state.

Fish collection procedures will focus on a multihabitat approach, allowing the sampling of habitats in relative proportion to their local availability. Each sample reach should contain riffle, run and pool habitat, when available. Whenever possible, the sample reach should be sampled sufficiently upstream of any bridge or road crossing to minimize the hydrological effect on overall habitat quality. Wadability and accessibility may ultimately govern the exact placement of the sample reach.

## 2.2.5 Sampling SOP Modifications

The SOPs provided in the Compendium to this QAPP have been adopted from the standard operating procedures used by various members of the CDM Project Team and from SOPs developed by MADEP Division of Watershed Management (DWM). For the purposes of this project, all references to the specific Team member (such as "DWM" or "MassDEP") shall be replaced by the "CDM Project Team." References to the "Wall Experiment Station (WES)" shall be replaced by the SMAST Coastal Systems Program Analytical Facility at the University of Massachusetts, Dartmouth (SMAST laboratory).

Sampling SOP modifications are described in the SOP Compendium (Appendix C).

## 2.2.6 Sampling/Measurement System Failure Response and Corrective Action

This section describes the sample and measurement system failure response and corrective action procedures that will be undertaken during field and laboratory activities.

**Field Corrective Actions**

Corrective action in the field may be required when a modification is made to the sampling network (*e.g.* changes in the frequency or number of samples taken or changes in sampling locations) or when sampling procedures or field analytical methods require modification due to unexpected conditions. Any member of the CDM Project Team may identify a problem requiring corrective action; the field staff in consultation with the Field Program Coordinators

will then recommend the corrective action. The Technical Project Manager will approve the corrective measure, which will be implemented by the members of the CDM Project Team. The Technical Project Manager will inform the Study Manager of the problem and corrective action. All sampling or measurement system failures and resulting corrective actions will be accurately documented in the field logbooks. No member of the CDM Project Team may initiate corrective action without prior communication through the proper channels, as described above.

### Laboratory Corrective Actions

Corrective action in the laboratory may occur prior to, during, or after initial analyses. A number of conditions, such as broken sample containers, multiple phases, low/high pH readings, and potentially high concentration samples may be identified during the sample log-in or just prior to analysis. The bench chemist will identify the need for corrective action. The Laboratory Supervisor, in consultation with the laboratory staff, will approve the required corrective action for implementation by the laboratory staff. The laboratory QA Officer will approve and document the corrective action in accordance with the laboratory's Quality Assurance Plan.

All corrective actions shall be performed prior to the release of the data from the laboratory. The corrective action will be documented in both the laboratory's corrective action file and the narrative data report sent from to the Technical Project Manager. If the corrective action does not rectify the situation, the laboratory will contact the Technical Project Manager.

## 2.3 Sample Handling and Custody

This section of the QAPP describes the procedures by which sample custody will be maintained by all members of the CDM Project Team and by the analytical laboratories. Also described are the sample handling and transport procedures that will be employed throughout the project.

### 2.3.1 Sample Labeling

Sample labels with be attached to individual sample aliquots for each investigation or quality control sample. Field Program Coordinators will be responsible for ensuring that all labels are affixed to the bottles prior to event mobilization. Primary sample labels will include the following information:

- Name of the investigation
- Sample identification number
- Date and time of collection

A second label may be affixed that includes the following supplemental information:

- Sample collection location

- Number of sampling event
- Analysis requested
- Preservative

The unique sample identification numbers will be specified in accordance with the following guidance:

**Water Quality Samples (Low flow surveys)**

Example: BRWA-XXX-A-B

BRWA – denotes Brockton Receiving Water Assessment SEP surveys and will be the same for all samples

XXX– three digit Station ID, as per Sampling and Analysis Plan, designates sampling location (i.e. 001 for station 1)

A – Number of sampling event (chronological order, 1-2)

B – Analysis requested (abbreviated), see Table 2-5

Fictitious station numbers will be developed to identify the field blanks and duplicate samples in accordance with the following designations:

Series 000 – regular water quality samples

Series 100 – field blanks

Series 200 – duplicates

Series 300 – equipment blanks

Table 2-5 presents a summary of the abbreviations to be used for each of the water quality parameters on the sample labels.

*Table 2-5: Water Quality Constituent Abbreviations for Sample Labels*

| Analytical Constituent | Abbreviation |
|---|---|
| Dissolved Oxygen (Winkler Titration) | DO |
| Total Dissolved Solids | TDS |
| Total Phosphorus | TP |
| Dissolved Orthophosphorus | OP |
| Nitrate/Nitrite | NO23 |
| Ammonia-N | NH3 |
| Chlorophyll-a | ChlA |

Example labels are shown in Figures 2-1 and 2-2, for a total phosphorus sample collected during the first survey from Station 4:

*Figure 2-1: Example Water Quality Primary Sample Label*

City of Brockton - CDM
**Brockton Receiving Water Assessment SEP**
UMass Dartmouth SMAST laboratory
Sample Date/Time: 08/04/2010 1435
Sample ID: BRWA-004-1-TP

*Figure 2-2: Example Water Quality Secondary Sample Label*

City of Brockton - CDM
**Brockton Receiving Water Assessment SEP**

BRWA-004-1-TP
Station: 004
Low Flow Survey 1

Preservative: $H_2SO_4$
Analysis: Total Phosphorus

### 2.3.2 Chain-of-Custody Procedures

Each sample must be properly documented to ensure the timely analysis of all parameters requested and to track the progress of the samples in the laboratory. To this end, chain-of-custody forms will be completed for all samples collected.

Chain-of-custody forms will be filled out by the respective sampling crews at the end of each sampling round; the sample numbers and locations will be listed on the forms. When transferring sample custody, the individuals relinquishing and receiving the samples will sign, date, and note the time on the record. This record documents the transfer of sample custody from the sampler to another person, to the laboratory, or to/from a secure storage area. Representatives from both the CDM Project Team and the laboratories will retain a copy of the forms. The chain-of-custody forms will be kept until all data has been received from the laboratories. An example chain-of-custody form is shown in Figure 2-3.

Specific laboratory custody procedures will be described in the selected laboratory's Quality Assurance Plans, and will include:

- Chain-of-custody procedures for assuming control of field samples
- Detailed sample log-in procedures
- Detailed internal sample tracking procedures
- Procedures for internal transfer of sample custody
- Specifications for sample storage
- Disposal procedures for samples, extracts, and digestables
- Procedures for custody of analytical data and final data storage

## CDM Chain-of-Custody

One Cambridge Place, 50 Hampshire Street, Cambridge, MA 02139 Phone: (617) 452-6000

### Brockton Comprehensive Receiving Water Assessment SEP

Sampling Event: ____

| Sample ID | Container | Pres | Lab:Analyte(s) | Sample Date/Time/Initials | Comments |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| Relinquished by: | Date & Time: | Received by: | Date & Time: | Comments |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

*Figure 2-3: Example Chain of Custody Form*

## 2.3.3 Sample Handling and Packaging

All grab samples will be collected in clean, pre-preserved bottles supplied by the contracted laboratories in accordance with the applicable SOPs. Samples will be placed in laboratory-supplied coolers with sufficient ice to meet preservation and holding requirements. A chain-of-custody form for the samples will be placed in a sealable, waterproof plastic bag and placed inside the cooler. All samples will be preserved in accordance with specified analytical guidelines. Table 2-6 provides a summary of the required sample volumes, collection containers, holding times, and preservatives for each water quality parameter.

*Table 2-6: Summary of Analyte Collection Container, Holding Time, and Preservative*

| Parameter | Container Type | Container Volume | Processing & Preservation | Holding Time |
|---|---|---|---|---|
| Nitrate + Nitrite NO3 + NO2 | acid washed polyethylene bottle | 60 CC | Filtered and stored in the dark at 4° C. | 48 hrs |
| Ammonia, NH3 | acid washed polyethylene bottle | 60 CC | Filtered and stored in the dark at 4° C. | 12-24 hrs |
| Total Dissolved Nitrogen (Dissolved Organic Nitrogen, DON) | acid washed polyethylene bottle | 60 mL | Filtered and stored in the dark at 4° C. | 12-24 hrs |
| Ortho-Phosphate, PO4 | acid washed polyethylene bottle | 60 mL | Filtered and stored in the dark at 4° C. | 12-24 hrs |
| Particulate Carbon/Nitrogen | acid washed polyethylene bottle | 1 L | Stored at 4°C | 12-24 hrs |
| Total Phosphorus | acid washed polyethylene bottle | 60 mL | Sample acidified and stored at 4°C | 28 days |
| Alkalinity | acid washed polyethylene bottle | 1 L | Stored at 4°C | 12-24 hrs |
| Chlorophyll a | acid washed dark polyethylene bottle | 1 L | Stored in the dark at 4°C | 12-24 hrs |
| Dissolved Oxygen (Winkler Titration) | BOD bottle | 300-mL | Manganous sulfate & alkali-iodide azide (added in the field); 4°C | 8 hours |

*Note: Should there be any changes in specifications once laboratories are contracted, this table will be updated and appended to the QAPP*

Field samples collected by CDM Project Team sampling crews may be picked-up by couriers from the laboratories at predetermined locations in the field, delivered to the laboratories by the CDM Project Team, or shipped to the laboratories. The sampling crews will either meet designated couriers from the laboratories at centrally accessible locations, ship via FedEx, or transport samples directly to the laboratories, where sample custody will be relinquished. Sample delivery will be performed in a timely manner to meet the required holding times for all analytes (Table 2-6).

## 2.4 Analytical Methods

Analytical methods are written instructions that describe how to prepare a sample for analysis, prepare and calibrate test equipment, perform the test, and calculate results. This section of the QAPP identifies the analytical field and laboratory measurements that will be made in support of the Brockton Receiving Water Assessment SEP Study. Detailed information on field measurement techniques are included in Section 2.3 and referenced SOPs; all laboratory methods are documented in the applicable laboratory SOPs (see SOP Compendium).

### 2.4.1 Field Analytical Methods

This section describes the field analytical methods that will govern the *in situ* water quality and streamflow measurements conducted as part of this project.

#### *In situ* Measurements

*In situ* measurements for temperature, DO, pH, conductivity, and turbidity will be performed on all grab samples collected during the low flow sampling events. Diurnal DO sweeps will be conducted at all sampling stations during the summer low flow event surveys; measurements will be made at or near dawn and again during the late afternoon.

Portable field units with specifically designed electronic sensors capable of taking *in situ* measurements will be used during all sampling events. All equipment will be furnished by members of the CDM Project Team or rented from an approved distributor. A list of the field analytical equipment and operating ranges is provided in Table 2-7.

*Table 2-7: CDM Field Analytical Equipment and Operating Ranges*

| Equipment (Make/Model) | Analyte(s) Measured | Operating Range | Resolution | Accuracy |
|---|---|---|---|---|
| YSI Model 556 MPS | Conductivity | 0 to 200 mS/cm | 0.001 µS/cm to 0.1 mS/cm | 4-meter cable: Greater of ±0.5% of reading or ±0.001 mS/cm; 20-meter cable: Greater of ±1.0% of reading or ±0.001 mS/cm |
| | pH | 0 to 14 units | 0.01 units | ±0.2 units |
| | Temperature | -5 to +45 °C | 0.01°C | ±0.15°C |
| | Dissolved Oxygen | 0 to 50 mg/L | 0.01 mg/L | 0 to 20 mg/L: Greater of ±2% of the reading or 0.2 mg/L; 20 to 50 mg/L: ±6% of the reading |
| | | 0 to 500% air saturation | 0.1% air saturation | 0 to 200% air saturation: Greater of ±2% of the reading or 2% air saturation 200 to 500% air saturation: ±6% of the reading |
| Hach 2100P | Turbidity | 0-1000 NTU | 0.01 on lowest range | ±2% of reading or ±1 least sig digit (0 to 500 NTU); ±3% of reading from 500 to 1000 NTU |

All *in situ* temperature, DO, pH, and conductivity measurements will be collected in accordance with SOP-FLD-003: *In-Situ Water Quality Measurements.*

All field equipment will measure the expected range of the *in situ* parameters. The use of nonstandard field analytical methods is not required for this project.

Failures in the field analytical system will be addressed in accordance with Section 2.2.9 - Sampling/Measurement System Failure Response and Corrective Action; this section also specifies the individuals responsible for corrective action and how the effectiveness of the corrective action will be determined and documented.

## 2.4.2 Laboratory Analytical Methods

The laboratories selected for analyses of samples will provide effective and timely analyses of the environmental samples collected for the Brockton Receiving Water Assessment SEP Study. The required turnaround time for laboratory reports to be provided to the CDM Project Team is 28 days. Whenever possible, Electronic Data Deliverables (EDDs) shall be provided.

Table 2-8 presents a summary of the expected analytical methods, method detection limits, and reporting limits that will be required by the laboratories selected to analyze collected samples.

Method Detection Limits (MDLs) are the lowest values at which a parameter can be measured using the reference method. The MDL is defined as the constituent concentration that, when processed through the complete method, produces a signal with 99 percent probability that it is different from the blank. MDLs are developed for each particular analyte of interest and are established as targets for ensuring that the data quality obtained is adequate for interpreting the data; these MDLs are the minimum to be achieved by the selected laboratories. The reporting limit (RL) is defined as the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

Analytical methods will be performed in accordance with the applicable laboratory SOP, which is included in Appendix C (SOP Compendium). All equipment requirements are specified in the respective laboratory SOPs.

*Table 2-8: Summary of Analytical Methods, Laboratory Responsibilities, MDLs, and Reporting Limits*

| Analytical Parameter | Matrix | Method (Ref) | Units | Lower Detection Limits | Accuracy and Precision >* |
|---|---|---|---|---|---|
| Nitrate + Nitrite NO3 + NO2 | Surface water, porewater, wastewater | Automated Cadmium Reducation Method (a) | uM | 0.05 | 5% |
| Ammonia, NH3 | Surface water, porewater, wastewater | Phenate Method (b) | uM | 0.1 | 5% |
| Total Dissolved Nitrogen (Dissolved Organic Nitrogen, DON) | Surface water, porewater, wastewater | Persulfate Digest & Automated Cadmium Reducation Method (a, c) | uM | 0.05 | 5% |
| Ortho-Phosphate, PO4 | Surface water, porewater, wastewater | Ascorbic Acid Method (d) | uM | 0.1 | 5% |
| Particulate Carbon/Nitrogen | Surface water | Elemental analysis (e) | ug/L | 10 ug | 10% |
| Total Phosphorus | Surface water, porewater, wastewater | Persulfate Method (a, c, d) | uM | 0.05 | 5% |
| Alkalinity | Surface water, porewater, wastewater | Titration (f) | Mg/L CaCO3 | 0.5 | 5% |
| Chlorophyll a | Surface water | Cold 90% acetone extract, acid corrected (g) | ug/L | NA | 10% |

*Accuracy based on results of laboratory control standard; precision based on relative percent difference of duplicate samples
NA: not applicable
References are listed on the following page.

**References**

a QuikChem Method 10-107-04-1-J (0-700uM) and 31-107-04-1-C (0-50 and 0-10uM). Zellweger Analytics, Lachat Instruments Division, Milwaukee, WI USA. Quik Chem method based upon the following techniques:
Method 4500-NO3- F. Automated Cadmium Reduction Method, Standard Methods.
Wood, E., F. Armstrong and F. Richards. 1967. Determination of nitrate in sea water by cadmium copper reduction to nitrite. J. Mar. Biol. Ass. U.K. 47:23-31.
Bendschneider, K. and R. Robinson. 1952. A new spectrophotometric method for the determination of nitrite in sea water. J. Mar. Res. 11: 87-96.

b Ammonia method based upon the following techniques:
Scheiner, D. 1976. Determination of ammonia and Kjeldahl nitrogen by indophenol method. Water Resources 10: 31-36. Method 4500-NH3 D. Phenate Method, Standard Methods.

c D'Elia, C.F., P.A. Stuedler and N. Corwin. 1977. Determination of total nitrogen in aqueous samples using persulfate digestion. Limnol. Oceanogr. 22: 760-764.

d. Murphy, J. and J.Riley. 1962. A mondified single solution method for the determination of phosphate in natural waters. Analyticaa Chimica Acta 27:31-36. Method 4500-P E. Ascorbic Acid Method, Standard Methods.

e. Perkin-Elmer Model 2400 CHN Elemental Analyzer Technical Manual.

f. Method 2320 Alkalinity, Standard Methods. Hach alkalinity Titration Kit, Digital Titrator Model 16900-01

g. Parsons, T.R., Y.Maita and C.Lalli. 1989. Manual of Chemical and Biological Methods for seawater analysis. Pergamon Press, 173 pp.

Failures in the laboratory analytical system will be addressed in accordance with Section 2.2.3 - Sampling/Measurement System Failure Response and Corrective Action; this section also specifies the individuals responsible for corrective action and how the effectiveness of the corrective action will be determined and documented.

# 2.5 Quality Control

Quality Control (QC) is the system of technical activities that measures the performance of a process. Internal QC checks will be performed for sampling, field, and laboratory analysis to verify compliance with project investigation requirements in accordance with the DQOs and Measurement Performance Criteria established in Section 1.4 - Quality Objectives and Criteria.

This following section describes the general QC procedures that have been established for the Brockton Receiving Water Assessment SEP Study; specific information as to the location and types of quality control checks will be provided in the Sampling and Analysis Plan.

## 2.5.1 Field Quality Control Checks

### Field Performance Audits

The intent of field performance audits is to ensure that accepted SOPs are being implemented consistently between groups. Both scheduled or unscheduled field method performance evaluations may be conducted by CDM. Monitoring staff are advised to sample as they regularly do, and not to misrepresent how sampling is/will be typically occurring for their project. While not always possible, an attempt is made to field audit each person at least once. Sampling technicians for this project will be experienced in surface water sampling.

### Sampling Quality Control Check

Sampling QC will be assessed based on the use of field duplicates and field blanks that will be prepared in the field and transported to the subcontractor laboratories in accordance with standard procedures. The respective laboratories will analyze the QC samples in accordance with the analytical methods at the method-required frequency. A description of the QC samples follows.

***Field Duplicates***. Spatial composite and grab sample field duplicates will be collected by splitting the original sample. They will be carried through all phases of the sampling and analytical procedures in an identical manner to provide overall precision information for each sampling event.

Field duplicates will be collected for all parameters analyzed in the field at a frequency of five percent, or one duplicate per 20 samples.

***Field Blanks***. Field blanks will consist of distilled, deionized water. The blanks will be preserved as appropriate, will accompany the samples during transport to the laboratory, and will be analyzed as appropriate. Samples will be submitted blindly to the laboratory at a rate of five percent, or one blank per 20 samples.

The desired field precision, accuracy, and field blank cleanliness for each parameter based on the quality objectives set forth in this QAPP is provided in Table 1-2. Precision and accuracy will be calculated in accordance with the procedures established in Section 1.4 - Quality Criteria and Objectives. Outlier data points will be considered on an individual basis and may be qualified depending on both upstream and downstream data measurements and on concentrations measured at different times, as applicable.

### Field Analytical Quality Control Checks

Quality control checks on all instruments used to conduct field measurements will be conducted on a pre-determined basis; specific procedures will be discussed further in Sections 2.6 and 2.7. *In situ* DO measurements will be further verified using laboratory DO Winkler Titration methods at selected stations, as described in the Sampling and Analysis Plan.

## 2.5.2 Laboratory Quality Control Check

The analytical laboratory will use the procedures outlined in their Quality Assurance (QA) Plan to ensure the reliability and validity of analytical results. The most recent version of these Plans is included as an attachment to Appendix C (SOP Compendium).

Compliance with the QA Plans is coordinated and monitored by the respective laboratory's QA Officer. QC samples prepared by the laboratories may include, as specified in the respective Plans:

- Laboratory duplicates and blanks

- Matrix spikes and matrix spike duplicates (MS/MSDs)
- Laboratory Control Standard and Laboratory Control Standard Duplicates (LCS/LCSDs)

Additional information regarding laboratory QC procedures is provided in the specific analytical SOPs (see SOP Compendium). Specific criteria for the evaluation of laboratory precision and accuracy are provided in Section 1.4 - Quality Objectives and Criteria and Table 1-2. Any samples analyzed in nonconformance with the QC criteria will be reanalyzed in the respective laboratory if sufficient sample volume is available.

## 2.6 Instrument/Equipment Testing, Inspection, and Maintenance

This section of the QAPP describes the procedures and documentation activities that will be performed during the field sampling program to ensure that all equipment is in working order.

### 2.6.1 Field Instruments and Equipment

The inspection, testing, and maintenance of all field equipment and instruments will be performed in accordance with the applicable SOPs as noted in Section 2.4.1. Field meters designed for the collection of *in situ* temperature, pH, DO, and conductivity (as per Table 2-9) will be visually inspected prior to use and tested through the comparison of readings to pH and conductivity standard solutions.

In all cases, specific preventative maintenance procedures as defined by the respective manufacturers will be followed. Additionally, field notes from previous sampling events will be reviewed by the respective Field Program Coordinators, or designated substitutes, to ensure that any previous equipment problems have been identified, and that all necessary repairs have been made.

The Field Program Coordinators, or a designated substitute, will be responsible for testing, inspection, and maintenance of all equipment prior to mobilization. The designated CDM Project Team member will then be responsible for completing the Equipment Inspection, Testing, and Maintenance Sheet; an example will be provided in the Sampling and Analysis Plan.

### 2.6.2 Laboratory Instruments

Each laboratory will perform routine preventative maintenance in accordance with their respective Quality Assurance Plans and with manufacturer's specifications to minimize the occurrence of instrument failure and other system malfunctions. Each laboratory will maintain factory-trained repair staff with in-house spare parts or will maintain service contracts with applicable vendors.

Records of preventative maintenance, equipment repairs and replacement, and documentation of maintenance procedures will be maintained by the designed laboratory Quality Assurance Officer, and subject to auditing by the CDM Project Team QA Officer.

## 2.7 Instrument/Equipment Calibration and Frequency

This section describes the calibration procedures that will be followed for all equipment used to conduct field and laboratory analyses to maintain reliable and accurate measurement results. All calibrations will be performed in accordance with manufacturer's recommendations.

### 2.7.1 Field Instruments and Equipment

Instruments and equipment used to perform *in situ* measurements, including temperature, pH, conductivity, and DO, will be calibrated before the sampling event to ensure accuracy and reproducibility of the results are consistent with the manufacturer's specifications and applicable SOP. Group calibration checks of multimeters to be used during the sampling event will occur prior to taking any samples in the morning, and at the end of the sampling event. The meters will be recalibrated as necessary based on the results of the check.

Table 2-9 provides a list of the field equipment to be used to during the sampling program and denotes the required calibration method. Additional information is provided in the respective SOPs.

*Table 2-9: Summary of Field Instrument/Equipment Calibration Method*

| Instrument/Equipment | Calibration Method |
|---|---|
| DO membrane electrode (probe) | Air saturation and zero calibration |
| Specific Conductance | Manufacturer's two-point method |
| Thermometers | Calibrated against NIST certified/traceable thermometer |
| Thermistors (contained in DO probes) | Checked against previously calibrated hand thermometers |
| pH (electrometric method) | Calibration based on standard solution |
| Portable turbidimeter | Periodic calibration per manufacturer's instructions; field calibration is not required |

The Field Program Coordinator, or designated substitute, will be responsible for ensuring that all equipment has met the required calibration standards prior to event mobilization. In the event that an internally calibrated field instrument fails to meet calibration/check-out procedures, it will be returned to the manufacturer for service. Calibration procedures and frequency will be recorded in a field logbook and on the Equipment Calibration Sheet (see Sampling and Analysis Plan) along with instrument identification numbers and the buffer solution lot numbers, where appropriate. All standard solutions used during the calibration

process will be specifically designed for the instruments being calibrated and inspected per the guidance in Section 2.8.

### 2.7.2 Laboratory Instruments/Equipment

Calibration procedures and frequencies of all laboratory equipment will be performed in accordance with the respective laboratory's Quality Assurance Plans, manufacturer's specifications, analytical SOPs, and written procedures approved by laboratory management. Records of calibration method and frequency will be filed and maintained by the designated laboratory Quality Assurance Officers; these may be subject to auditing by the CDM Project Team QA Officer.

## 2.8 Inspection and Acceptance of Supplies and Consumables

All supplies to be used during the field sampling program will be inspected prior to acceptance to ensure that they are in satisfactory condition and free of defects or contamination in accordance with the methods specified in Table 2-10.

*Table 2-10: Summary of Supplies and Inspection Requirements*

| Critical Supplies and Consumables | Inspection Requirements and Acceptance Criteria |
|---|---|
| Sample bottles | Visually inspected upon receipt for cracks, breakage, cleanliness, and preservation solution (as needed) |
| Chemicals and reagents | Visually inspected for proper labeling, expiration dates, and approximate grade |
| Water quality monitors | Functional checks to ensure proper calibration and operating capacity per Sections 2.6 and 2.7 |
| Sampling equipment | Visually inspected for obvious defects, damage, and contamination |

The respective Field Program Coordinator, or designated substitute, will be responsible for ensuring the acceptability of all material to be used during field activities prior to event mobilization and for implementing corrective action, if necessary. Designated personnel from the selected analytical laboratories will be responsible for the inspection and acceptance of all material relating to laboratory analysis.

## 2.9 Non-Direct Measurements

Flow and precipitation data will be gathered from USGS streamflow monitoring gage 01108000 on the Taunton River (http://waterdata.usgs.gov/nwis/uv?01108000).

In addition, antecedent precipitation reported at the Taunton, Massachusetts National Oceanic and Atmospheric Administration (NOAA) weather station (http://www.erh.noaa.gov/box/dailystns.shtml) will be compiled for 5 days prior to sampling and for the day of sampling.

Weather forecasts will be analyzed from the NOAA National Weather Service (NWS) for Bridgewater, MA for the purpose of selecting appropriate sampling dates.

## 2.10 Data Management

This section describes the data management strategies that will be used during the collection, review, and reduction of all environmental data collected as a part of the Brockton Receiving Water Assessment SEP.

### 2.10.1 Data Recording, Handling, and Tracking

This section details the computerized and manual data recording, handling, and tracking procedures that will be used during the sampling program.

#### Data Recording and Tracking

***Field Data.*** Field environmental measurements collected by the CDM Project Team during sampling events will be recorded in field logbooks and field data collection forms in accordance with guidance provided in Section 1.6 Documents and Records. Upon completion of the sampling event, the data collected will be transposed to a project-specific electronic database, the format of which will be discussed in subsequent sections. The transfer of data from paper (*i.e.* logbooks or collection forms) to electronic format will be performed by a designated member of the CDM Project Team; a second individual will then spot check the entries.

Copies of all field data will be maintained by CDM in a Final Evidence File in accordance with the document retainage and control guidelines discussed in Section 1.6.

***Laboratory Data.*** Laboratory results will be reported in accordance with the guidance provided in Section 1.6. All information related to sample analysis will be documented in controlled laboratory logbooks, instrument printouts, or other approved forms in accordance with the laboratory's Quality Assurance Plan. Analytical laboratory records will be reviewed by the respective laboratory Quality Assurance Officer, and subject to auditing by the CDM Project Team QA Officer.

Prior to releasing the final data, each laboratory will employ a tiered review process. Each analyst will be responsible for reviewing the analytical and quality control that he/she has generated; the analyst will verify that:

- The appropriate methodology has been used
- Instrumentation and equipment was functioning properly

- QC analyses were performed at the proper frequency and the analyses met the acceptance criteria
- Samples were analyzed within the required holding times
- All analytes were quantitated within the calibration range
- Matrix interference problems were confirmed
- Method specific analytical requirements were met
- Calculations, dilution factors, and detection limits were verified

The raw data will then be released to the respective area supervisor who will also review the data for attainment of quality control criteria as required in the applicable standard method and for overall reasonableness. The Technical Project Manager will be responsible for generating the data summary report, which will be reviewed by the laboratory Quality Assurance Officer. This review will verify that the report format and content meet the client specifications, that the data were reported correctly, and that analytical and quality control problems were addressed and documented in the file and summary report (if appropriate). Upon acceptance of the preliminary reports by the QA Officer, the final reports will be generated and signed by the Laboratory Project Manager.

Following the receipt of the signed data reports by the CDM Project Team Technical Project Manager or designated substitute, all results will be transposed or uploaded to the electronic database by a member of the CDM Project Team. Data transcription will be spot checked by a second member of the Team. The final database will include all the data provided by the laboratories, as well as laboratory-provided data flags, including:

- Concentrations below the required detection limits
- Estimated concentration due to poor relative percent difference
- Estimated concentration due to poor spike recovery or other outlying QC data
- Concentration of chemical also found in laboratory blank

### Data Handling

All chemical analysis data gathered or generated as part of the Sampling and Analysis Plan will be entered into a project-specific database, developed using Microsoft Access. Data will be organized according to the unique sampling station locations (*i.e.* Station ID) provided in the Sampling and Analysis Plan. Each site will be referenced based on its latitude and longitude. The database will include at a minimum:

- Sampling date (MM-DD-YYYY)
- Sampling round (1, 2)
- Station ID
- County where sampling station is located
- Station longitude and latitude
- GeoMethod- Geopositioning method used to determine state latitude and longitude
- GeoDatum- Datum that longitude and latitude coordinates are in
- Sample collection time
- Sample type (*e.g.* vertically integrated quarterpoint spatial composite, vertically integrated centerpoint sample, bacteria grab sample, outfall grab sample)
- QC sample type, if applicable (duplicate - DUP or blank - BL)
- Parameter ID (Table 2-5)
- Analytical results (*i.e.* constituent concentration)
- Units
- Reporting limits
- Analyzing laboratory
- *In situ* measurements, including pH, temperature, conductivity, DO, turbidity, Secchi disk depth (select stations, biological monitoring events only)
- Data Qualifier (Table 2-11)
- Brief field or laboratory notes

Field and laboratory analytical data will be flagged based on the results of the data validation described in Section 4. Table 2-11 presents a summary of the data qualifiers or "flags" that will be used throughout the database, as specified in the "Region 1 Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses" (USPEA 1988).

*Table 2-11: Summary of Laboratory Analysis Data Qualifiers*

| Data Qualifier | Description |
|---|---|
| U | The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantification limit or the sample detection limit |
| J | The associated value is an estimated quantity |
| R | The data are rejected |
| UJ | The material was analyzed for but not detected. The associated value is an estimate and may be inaccurate or imprecise. |

The following data qualifiers or symbols are used in the MADEP/DWM WQD database for qualified and censored water quality and multi-probe data. Decisions regarding censoring vs. qualification for specific, problematic data are made based on a thorough review of all pertinent information related to the data.

General Symbols (applicable to all types):

" ## " = Censored data (i.e., data that has been discarded for some reason). NOTE: Prior to 2001 data, "**" denoted either censored or missing data.

" ** " = Missing data (i.e., data that should have been reported). See NOTE above.

" -- " = No data (i.e., data not taken/not required)

* = Analysis performed by Laboratory OTHER than DEP's Wall Experiment Station (WES)

[ ] = A result reported inside brackets has been "censored", but is shown for informational purposes (e.g., high blank results).

Multi-probe-specific Qualifiers:

" i " = Inaccurate readings from multi-probe likely; may be due to significant pre-survey calibration problems, post-survey checks outside typical acceptance ranges for the low ionic and deionized water checks, lack of calibration of the depth sensor prior to use, or to checks against laboratory analyses. Where documentation on unit pre-calibration is lacking, but SOPs at the time of sampling dictated pre-calibration prior to use, then data are considered potentially inaccurate.

" m " = Method not followed; one or more protocols contained in the multi-probe SOP not followed, i.e., operator error (e.g., less than 3 readings per station (rivers), or instrument failure not allowing method to be implemented).

" s " = Field sheet recorded data were used to accept data (i.e., not data electronically recorded in a data logger or in cases where data logging is not possible (e.g., single-probes)).

" u " = Unstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc.

" c " = Unit not calibrated for a particular parameter and/or greater than calibration standard used for pre-calibration, or outside the acceptable range about the calibration standard. Typically used for conductivity (>718, 1,413, 2,760, 6,668 or 12,900 uS/cm) or turbidity (>10, 20 or 40 NTU).

" r " = Data may not be representative of actual field conditions.

" ? " = Light interference on turbidity sensor (multi-probe error message). Data is typically censored.

Sample-Specific Qualifiers:

" a " = Accuracy as estimated at the laboratory via matrix spikes, sample recoveries, internal check standards and lab-fortified blanks did not meet project data quality objectives identified for program or in QAPP.

" b " = Blank Contamination in lab reagant blanks and/or field blank samples (indicating possible bias high and false positives).

" d " = Precision of field duplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP. Batched samples may also be affected.

" e " = Not theoretically possible. Specifically, used for bacteria data where colonies per unit volume for e-coli bacteria > fecal coliform bacteria, for lake Secchi and station depth data where a specific Secchi depth is greater than the reported station depth, and for other incongruous or conflicting results.

" f " = Frequency of quality control duplicates did not meet data quality objectives identified for program or in QAPP.

" h " = Holding time violation (usually indicating possible bias low)

" j " = 'Estimated' value; can be used for lab-related issues where certain lab QC criteria are not met and re-testing is not possible (as identified by the laboratory). Also used to report sample data where the sample concentration is less than the 'reporting' limit or RDL and greater than the method detection limit or MDL (MDL< x <RDL). Also used to note where values have been reported at levels less than the MDL. Also used for estimated ranges based on known metadata.

" m " = Method SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix, lab error (eg. cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, lost/unanalyzed samples, use of expired reagents and missing data.

" p " = Samples not preserved per SOP or analytical method requirements.

" r " = Samples collected may not be representative of actual field conditions, including the possibility of "outlier" data and site-specific flow-limited conditions (e.g., pooled sites within flowing streams).

All electronic data files will be stored and maintained in accordance with the procedures detailed in Section 1.6 - Documents and Records.

Data collection for biological monitoring will follow procedures outlined in CN 226.0, QAPP Benthic Macroinvertebrate Program, which is included in the SOP compendium (Appendix C).

# Section 3
# Assessment and Oversight

Section 3.0 of this QAPP addresses the activities required for assessing the effectiveness of the field sampling program implementation and associated quality assurance and control activities. The purpose of the assessment is to ensure that the QAPP is implemented as prescribed and that appropriate responses are in place to address any non-conformances and deviations from the QAPP.

## 3.1 Assessments and Response Actions

Performance and system audits of both laboratory and field activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in this QAPP and corresponding Field Sampling Plan. Field and laboratory performance audits are performed as an independent evaluation, through a review of internal quality control checks and procedures, of the data being generated. System audits are conducted as an onsite review and evaluation of facilities, instrumentation, quality control practices, data validation, and documentation practices.

### 3.1.1 Field Audits

Internal system and performance audits of field activities (sampling and measurement) will be conducted by the CDM Project Team QA Officer. The scope of these audits may include, but is not limited to:

- Field sampling and measurement records
- Field instrument operating records
- Sample collection, handling, and packaging procedures
- Maintenance of QA procedures
- Chain-of-custody procedures

Audits typically occur at the onset of field operations to verify that all established procedures are implemented. The audits will involve review of field measurement records, instrumentation calibration records, and sample documentation.

### 3.1.2 Laboratory Audits

Internal system and performance audits will be conducted by the respective laboratories in accordance with their specified QA Plans. The type and frequency of these audits is dictated in the QA Plans. These QA Plans will be appended to this document once laboratories have been selected.

Additionally, external laboratory audits may be conducted by CDM if problems with the data are observed, such as errors in a laboratory's internal sample tracking.

### 3.1.3 Audit Reporting and Corrective Action

Audit reports will be generated by the responsible party (*i.e.* QA Officer) at the completion of each assessment. The audit report will identify proficiencies, deficiencies, and opportunities for improvement, as applicable.

Corrective action includes the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or practices that result in data quality beyond the required quality control performance standards. Such actions may occur during field activities, laboratory analyses, data validation, and data assessment.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. Any nonconformance with the established quality control procedures in the QAPP and Field Sampling Plan will be identified and corrected in accordance with the QAPP. The Technical Project Manager, or an approved substitute, will issue a Nonconformance Report for each condition. All corrective actions will be further documented in the QA section of the project deliverables.

#### Field Corrective Action

Corrective actions in the field will be implemented on a case-by-case basis. Minor response actions taken in the field to immediately correct a problem will be discussed with the respective Field Program Coordinator and documented in the field logbook. The corrective action will be verbally relayed to the Technical Project Manager. Major corrective actions taken in the field will require approval by the Field Program Coordinator and Technical Project Manager prior to implementation. Such actions may include revising procedures in the field, resampling, or retesting.

#### Laboratory Corrective Action

Corrective action undertaken by the laboratories will be completed in accordance the procedures outlined in their respective QA Plans. All corrective actions will be reported to the CDM Project Team's Technical Project Manager and will be documented in the respective data reports for each sampling round. The laboratories will also be required to take and document corrective actions for problems identified by CDM.

## 3.2 Reports to Management

During the active phases of the sampling project, CDM will submit a written status report to the MADEP identifying the activities performed, planned activities, and

updated schedules. The CDM Project Team will also develop a final Interim Task Report to summarize the sampling events and environmental data obtained during the sampling program.

Quality assurance reports will be provided to the MADEP Study Manager and the CDM QA Officer (copies) when data or measurement quality problems are encountered. As previously noted, all corrective actions and nonconformance problems will be documented in the field logbooks and Nonconformance Reports. These will be further detailed in the task deliverable.

# Section 4
# Data Validation and Usability

The data review, verification, and validation procedures and criteria to be performed by the CDM Project Team and subcontracted laboratories are addressed in this section of the QAPP. These procedures and criteria will identify and qualify data that do not meet the established measurement performance criteria.

## 4.1 Data Review, Verification, and Validation

Ten-percent of the data analyzed and reported by CDM's subcontracted laboratories will be validated. The validation efforts will be more heavily weighted towards samples collected at the beginning of the field sampling program to ensure the identification of reporting problems early in the program. The remaining 90-percent of the data will be evaluated to determine the precision, accuracy, representativeness, completeness, comparability, sensitivity and field QC samples. Additional information on the validation and evaluation methods is provided in Section 4.2.

Suspect calibration information for *in situ* measurements (*i.e.* samples collected using equipment that was later determined to be out of calibration) will be noted in the field logbook upon discovery. Measurements made during the period of suspect calibration will be flagged as questionable.

## 4.2 Verification and Validation Methods

Validation (10-percent of the data) will be conducted as described in MADEP DWM CN 000.8, "DWM Data Use Guidelines," and DWM CN 56.1, 56.2 and 56.3, as applicable. A validation report will be developed for each sample delivery group (SDG) that is validated until the 10-percent criterion is met. A summary of these specific SDG validation reports will be presented in a data evaluation summary. The specific SDG validation reports (usually presented in table format) will be an appendix to the Final Report.

Data evaluation (90-percent of the data) for precision, accuracy, representativeness, completeness, comparability, sensitivity and field QC sample parameters will include a review of holding times, preservation, method of preparation blanks, laboratory duplicates, matrix spikes/matrix spike duplicates (MS/MSDs), and/or laboratory control samples/laboratory control sample duplicates (LCS/LCSDs), sampling and analytical procedures, data usability, method detection limits, field rinsate blanks, and field duplicate results. During data validation and evaluation, analytical data may be qualified as specified in the above-referenced guidance documents. A data evaluation summary will be generated at the completion of the evaluation effort. This summary will include both the validation and evaluation results for the sampling event.

### 4.2.1 Corrective Action

The need for corrective action may be identified during either data validation or data assessment. Potential types of corrective action may include resampling by the field team (if possible) or reanalysis of samples by the subcontracted laboratory. These actions are dependent upon the ability to mobilize the field team and whether or not the data is necessary to meet the required project and DQOs.

If a CDM Project Team assessor identifies a needed corrective action, the Technical Project Manager will be responsible for approving the implementation of the response action. Problems that may be attributed to laboratory quality assurance issues will be brought to the attention of the laboratory's Quality Assurance Officer, who will determine what, if any, action is required. The laboratory QA Officer will be responsible for implementing and reporting the corrective action.

## 4.3 Reconciliation with User Requirements

One-hundred percent of the analytical data from the subcontracted laboratories will be either validated or evaluated. This review will consist of the following steps:

- Conduct preliminary data review
- Identify data limitations
- Draw conclusions from the data

The measured environmental and data will be compared to the applicable water quality standards for Massachusetts.

## 4.4 Reporting

The findings of the data reconciliation will be presented in the Final Report to be developed at the conclusion of the sampling program.

Draft and final reports submitted as part of this project will follow the guidelines specified in CN 0.71, "Data Submittal Guidelines," and CN 0.74, "Content for External Data Reports."

All draft and final data deliverables shall be checked for accuracy, organization, completeness, acceptable format and coherence prior to submittal.

The following media types and quantities of each ( ) shall be submitted:

- Paper reports (3)
- Labeled CD-ROM (containing report files (e.g., Adobe Acrobat, MS Word), spreadsheet (e.g., MS Excel) data table files, and other files as appropriate (e.g., compressed .jpg photos, Arc View GIS .shp files, etc.)

- e-files of report and data tables (via email; optional)
- Electronic Data Deliverable, EDD (optional and/or as requested, appropriate and feasible)

# Section 5
# References

40 CFR Part 131. 2000. United Stated Environmental Protection Agency. "Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Rule." *United States Code of Federal Regulations.*

APHA. 1995. Standard methods for the examination of water and wastewater. Published by the American Public Health Association, 1015 Fifteenth Street, NW, 2005.

Barbour, M.T., J.B. Stribling, and J.R. Carr. 1995. The multimetric approach for establishing biocriteria and measuring biological condition. pp. 63-80. in W.S. Davis and T.P. Simon (eds.). *Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making*. Lewis Publishers, Boca Raton, FL.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. *Rapid Bioassessment Protocols for Use in Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish. Second Edition.* EPA 841-B-99-002. Office of Water, US Environmental Protection Agency, Washington, DC.

ESS 2003. *Matfield and Salisbury Plain River Watersheds Nonpoint Source Pollution Assessment Report and Management Plan.* Prepared for DEP/DWM. Wellesley, MA.

Massachusetts DEP. *314 CMR 4.00: Massachusetts Surface Water Quality Standards.* Massachusetts Department of Environmental Protection Bureau of Waste Prevention. January 2007. Available for download at http://www.mass.gov/dep/water/laws/regulati.htm

Massachusetts DEP. Massachusetts Year 2002 Integrated List of Waters. Part 2 – Final Listing of Individual Categories of Waters. Massachusetts Department of Environmental Protection, Bureau of Resource Protection, Division of Watershed Management. Boston, Massachusetts. Available for download at http://www.mass.gov/dep/brp/wm/tmdls.htm

Massachusetts DEP, 2005. *Taunton River Watershed 2001 Water Quality Assessment Report.* Report Number: 62-AC-1, DWM Control Number: CN 94.0. Massachusetts Department of Environmental Protection, Division of Watershed Management, Worcester, Massachusetts.

MassGIS 2005. Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs. MADEP

2002 Integrated List of Waters (305(b)/303(d)) as of 2005; Land Use as of 1999; Town Boundaries as of 2002. Census TIGER Roads as of 2003. Major Drainage Boundaries as of 2003. Designated Shellfish Growing Areas as of July 2000. Downloaded January 2005. http://www.mass.gov/mgis/laylist.htm

United State Environmental Protection Agency (USEPA). 1988. Region 1 Laboratory *Data Validation Functional Guidelines for Evaluating Inorganics Analyses.*

United States Environmental Protection Agency (USEPA). April 1999. *National Recommended Water Quality Criteria - Correction.* EPA 822-Z-99-001.

United States Environmental Protection Agency (USEPA). 2001. *Protocol for Developing Pathogen TMDLs.* EPA 841-R-00-002.
(http://www.epa.gov/owow/tmdl/pathogen_all.pdf